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Editorial: Advances and Challenges in Ocean Wave Energy Harvesting

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Editorial on the Research Topic

Advances and Challenges in Ocean Wave Energy Harvesting

Wave energy resource is abundant and huge due to the vast oceanic area on the planet. On the other hand, exploitation of wave energy has never reached a satisfactory level that can replace to a large extent the traditional fossil fuel. The main disadvantage of wave power is the significantly random variability in several timescales: from wave to wave, with sea state, and from month to month (Falcão, 2010). This poses many super challenges to effectively and efficiently extract power from the sea waves.

The present collection of research articles reflects the most recent contributions coming forward on harvesting wave energy, six coming from China (which is not completely surprising because of China's massive investments in recent years) and one from Sweden. They include six technical articles (Ning et al., 2019; Zhang et al., 2019; Qiao et al., 2020; Tan et al., 2020; Wang et al., 2020; Zhou et al., 2020) and one comprehensive review (Malin et al., 2020). These research works cover several representative types of wave energy converters, including OWC (oscillating water columns) (Ning et al., 2019; Qiao et al., 2020), PA (point absorber) (Tan et al., 2020; Zhou et al., 2020), and Edinburgh Duck WEC (wave energy converter) (Zhang et al., 2019). Numerical investigation (Ning et al., 2019; Zhang et al., 2019; Malin et al., 2020; Qiao et al., 2020; Tan et al., 2020; Wang et al., 2020; Zhou et al., 2020), experimental study (Wang et al., 2020), and open sea test (Zhang et al., 2019) have all been performed in the trials on modeling either a single WEC or wave farms (Malin et al., 2020). In addition, the effort to the evaluation of the sea climate has also been made (Wang et al., 2020).

Zhang et al. (2019) developed a hybrid boundary element method applying eigenfunction expansion in the external domain and numerically compute the optimal capture width ratio of their modified Duck device based on the Edinburgh Duck WEC. Besides, Zhang et al. (2020) also show some measurement data of their open sea tests on the modified Duck device.

Ning et al. (2019) applied a fully nonlinear higher-order boundary element method and numerically investigate the influence of the step bottom configuration on the efficiency of an OWC. Experimental and CFD results in the literature have also been compared with, and good agreement is found. It is concluded that higher operational efficiency can be achieved by optimizing the step geometry and position for a given wave condition.

Tan et al. (2020) perform a parametric study on a two-body wave energy point absorber. They made substantial linearization on their nonlinear time-domain model in order to improve efficiency. Their case study suggests that utilizing sufficient small stiffness of the power take-off system and the floater and optimal mass of the bodies can help to achieve the maximum power output.

Malin et al. (2020) perform a very comprehensive review of the state of the art of wave energy park optimization, involving modeling methods, experiments, and optimization algorithms. Moreover, a set of

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impressive results have been presented to analyze how realistic, reliable, and relevant the methods and the results are. The readers are strongly recommended to read the elaborate contents of the study, which may enlighten good ideas on further exploring new directions.

Qiao et al. (2020) discuss the possibility of integrating an OWC with an offshore jacket platform. A numerical study based on the finite element method has been performed for the dynamic analysis of such a combination. It is found that the affiliated OWC device can bring green wave energy while causing an almost negligible effect on the dynamic responses.

Wang et al. (2020) carry out a physical experiment in the wave flume in investigating the generation process of focused waves using double wave groups with different peak frequency differences. It is found that the phase shifts are mainly caused by the third-order nonlinearity due to interactions between the two wave groups. More investigations are conducted with numerical simulations based on the high-order spectral (HOS) method on the evolution of freak waves in the real sea environment.

Zhou et al. (2020) develop a numerical method that supplements the potential flow theory with a viscous correction. They thereby apply this method to study the motion response and performance of a heaving point absorber WEC with flat, cone, and hemispherical bottoms. After calibration with CFD results, it is concluded that WECs with larger diameter-to-draft ratios (DDRs) are found to have a relatively smaller viscous effect and achieve effective energy conversion in a broader frequency range. More conclusions with different types of bottoms can be found in the article.

In the end, we would like to thank all the contributing authors and reviewers for their invaluable thoughts and insightful discussions. We also sincerely appreciate the journal editors and the publication team behind it. Without their hard effort, this article collection would never become possible.

AUTHOR CONTRIBUTIONS

YL drafted the article, followed by the improvements made by the four coauthors before submission. All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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